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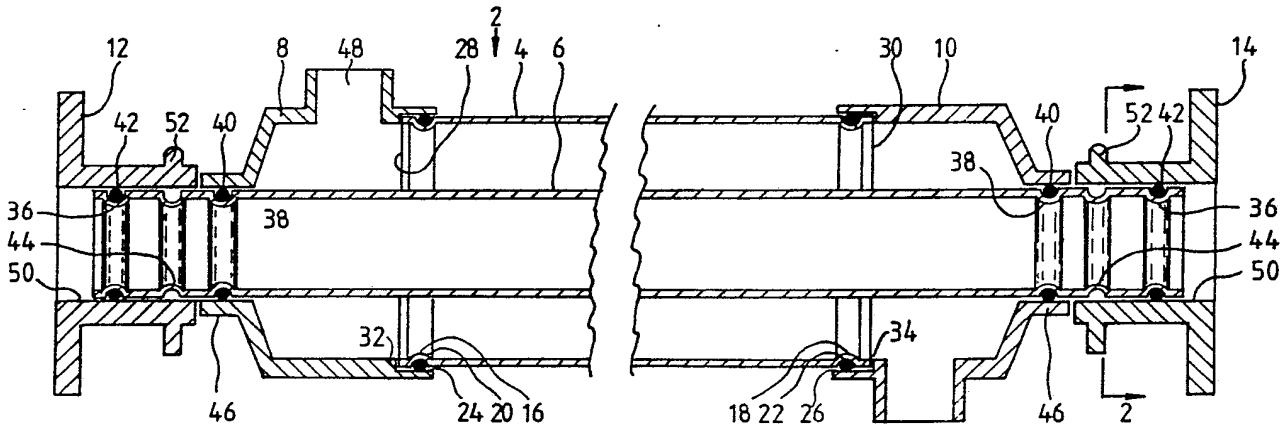

(57) Abstract

Heat exchanger comprising an inner tube (6), an outer tube (4), first and second end manifolds (8, 10) for receiving the ends of the inner and outer tubes, said tubes having sealing grooves (36, 38) plastically formed therein for receipt of sealing elements (40, 42) for sealing against adjacent surfaces of the end manifolds, said inner tube including locking grooves (44) plastically formed therein for receipt of locking pins (52) which extend into the end manifolds or into clamping members (12, 14) for fixing the axial position of the inner tube relative to the end manifolds, thereby clamping the outer tube between the end manifold. The heat exchanger is thus assembled without any welding and can be readily disassembled for cleaning or for use of the components in a different configuration.

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HEAT EXCHANGER

This invention relates to a heat exchanger.

The general object of the present invention is to provide a novel heat exchanger structure which can be assembled and disassembled in a simple and straight forward manner. The components used to form the exchanger are easy to form and therefore the exchanger is relatively inexpensive to make. The parts which are used in the exchanger can be used in a variety of ways thus affording a user flexibility in the utilization of components.

According to the present invention there is provided a heat exchanger comprising an inner tube, an outer tube, first and second end manifolds for receiving the ends of the inner and outer tubes, said tubes having sealing grooves plastically formed therein for receipt of sealing elements for sealing against adjacent surfaces of the end manifolds, said

inner tube including locking grooves plastically formed therein for receipt of locking pins which extend into the end manifolds or into clamping members for fixing the axial position of the inner tube relative to the end manifolds, thereby clamping the outer tube between the end manifolds.

Preferably, the end manifolds include shoulders against which the ends of the outer tubes abut.

In the simplest arrangement of the invention, the inner tube is concentrically disposed within the outer tube and the end manifolds are provided with ports so that the annular space between the inner and outer tubes serves as a jacket surrounding the inner tube. A product to be heated or cooled in passed through the inner tube.

By removal of the locking pins, the clamping members and or end manifolds can be removed and the inner and outer tubes separated so as to provide good access for cleaning the various components. The end manifolds can be used with tubes of different lengths and the clamping members can be used as couplings for coupling the exchanger to other conduits and/or equipment.

The invention will now be further described with reference to the accompanying drawings in which:

FIGURE 1 is a longitudinal cross-section through a preferred embodiment of the invention,

FIGURE 2 is a sectional view along the line 2-2, and

FIGURE 3 is a sectional view along the line 3-3.

Figures 1 to 3 show a heat exchanger 2 constructed in accordance with the invention. The heat exchanger comprises an outer tube 4 and an inner tube 6 concentrically located within the outer tube 4. The exchanger includes end manifolds 8 and 10 and a pair of clamping flanges 10 and 12.

The outer tube 4 is preferably formed from thin walled material and has grooves 16 and 18 formed near ends thereof. The grooves are plastically deformed into the wall of the tube by techniques such as rolling, pressing or hydraulic forming. This avoids the need for thick walled tubes to provide the thickness for machining in lathes. Such thickness is undesirable both because of cost and as an obstruction to heat transfer.The grooves 16 and 18 receive 0-rings 20 and 22 which form seals with rebates 24 and 26 formed in the end manifolds 8 and 10. The end faces 28 and 30 of the tube 4 bear against shoulders 32 and 34 at the ends of the rebates.

The inner tube 6 is formed at either end with two grooves 36 and 38 for receipt of 0-rings 40 and 42. Between the grooves 36 and 38 is formed a locking groove 44. The grooves 36, 38 and 44 are again plastically deformed into the thin walled tube 6 so as to again avoid the need for thick walled tubes. In the illustrated arrangement, the 0-rings 40 seal against the inner faces of spigot portions 46 of the end manifolds 8 and 10. The end manifolds include ports 48 so as to provide fluid communication

with the interiors of the manifolds and consequentially of the annular region between the two tubes 4 and 6. Thus a jacket is formed about the inner tube 6 and a heat transfer fluid can be passed through the jacket in the usual way.

The O-rings 42 bear against the inner faces of bores 50 which pass through the flange members 12 and 14 and form seals therewith. The flange members 12 and 14 can be used for forming couplings to conduits or other equipment. The flange members may be provided with male or female threaded parts (not shown) to assist in forming these connections.

The flange portions 12 and 14 are coupled to the inner tube by means of U-shaped pins 52, as best seen in Figures 2 and 3. The flanges includes holes 54 through which the legs of the pin 52 pass. As best seen in Figure 3, the holes 54 open to the bores 50 whereby the legs of the pin 52 can enter and engage with parts of the grooves 44 formed in the inner tube 6. This locks the axial position of the inner tube 6 with respect to the end manifolds 12 and 14. This effectively prevents axial movement of the end manifolds 8 and 10 because internal pressure within the manifolds 8 and 10 will cause the manifolds to firmly engage the flanges 12 and 14 so that the manifolds will be held firmly in position. Alternatively, the end faces of the spigots 46 of the manifolds can be arranged to bear against the adjacent faces of the flanges 12 and 14 so that there is no provision for any axial movement of the end manifolds.

In a modified arrangement, the flanges 12 and 14 can be formed integrally with the end manifolds 8 and 10. Alternatively the spigots 46 can be made longer and the holes 54 for receipt of the legs of the pin be provided directly in the end manifolds.

It will be appreciated that the heat exchanger of the invention can be assembled from components which are very easy to manufacture and which do not require specialized skills for their production. In particular, machining of grooves into thick walled tubes is not required. In addition, the assembly is held together by means of the pins 52 thereby avoiding the need for welding. It has been found from past experience that welding, particularly in stainless steel, of thin walled tubes requires highly skilled labour and is therefore relatively expensive. In addition once the components have been welded together, they cannot be separated for cleaning. In contrast, with the arrangement of the invention, the pins 52 can be removed to thereby enable the whole heat exchanger to be disassembled for cleaning. Further, a user can utilize standard components to make exchangers of different lengths and different combinations of materials depending upon the end use.

Many further modifications will be apparent to those skilled in the art without departing from the spirit and scope of the invention.

CLAIMS:

1. A heat exchanger (2) comprising an inner tube (6), an outer tube (4), first and second end manifolds (8,10) for receiving the ends of the inner and outer tubes, said tubes having sealing grooves (36,38,16,18) plastically deformed therein for receipt of sealing elements (42,40,20,22) for sealing against adjacent surfaces of the end manifolds, said inner tube including locking grooves (44) plastically deformed therein for receipt of locking pins (52) which extend into the end manifolds or into clamping members (12,14) for fixing the axial position of the inner tube relative to the end manifolds, thereby clamping the outer tube between the end manifolds.

2. A heat exchanger as claimed in claim 1 wherein the clamping members comprise end flanges (12,14) which project from cylindrical sleeves having bores (50) into which the inner tubes extend.

3. A heat exchanger as claimed in claim 2 wherein the sleeves are formed integrally with the end manifolds.

4. A heat exchanger as claimed in claim 2 or 3 wherein the sleeves include holes (54) which open to said bores (50) and wherein the pins (52) are received within the holes (54) and extend into the locking grooves (44).

5. A heat exchanger as claimed in claim 4 wherein the pins are snugly received in the holes and locking grooves.

6. A heat exchanger as claimed in claim 4 or 5 wherein the sleeves include one of the holes (54) on each side thereof and said pins are U-shaped and respective legs of the pins are received in the holes on opposite sides of the sleeves.

7. A heat exchanger as claimed in any preceding claim wherein the end manifolds include shoulders (32,34) against which the ends of the outer tubes abut.

8. A heat exchanger as claimed in any preceding claim wherein the inner tube is concentrically disposed within the outer tube and the end manifolds are provided with ports (48) so that the annular space between the inner and outer tubes serves as a jacket surrounding the inner tube.

9. A method of forming a heat exchanger comprising the steps of:

inserting a first tube (6) concentrically within a second tube (4);

providing sealing elements (42,40,20,22) in grooves (36,38,16,18) formed in the ends of the first and second tubes;

locating end manifolds (8,10) at the ends of the first and second tubes such that the sealing elements form seals therewith; and

fixing the axial position of at least one of said first and second tubes relative to the end manifolds by means of removable locking pins.

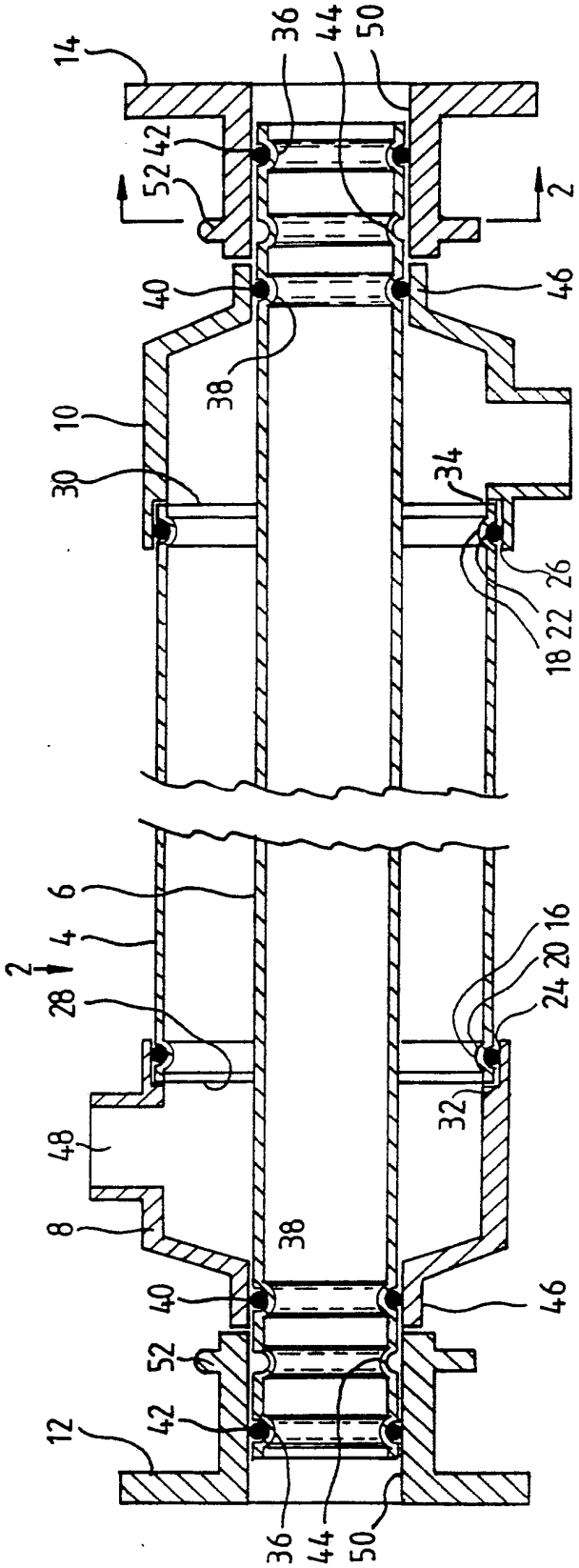
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FIG 1

FIG 3

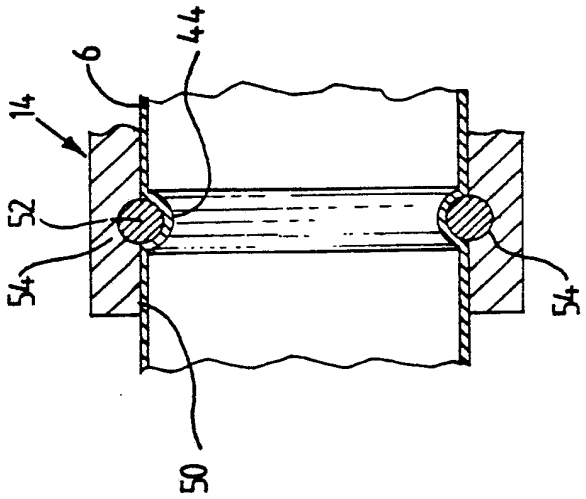
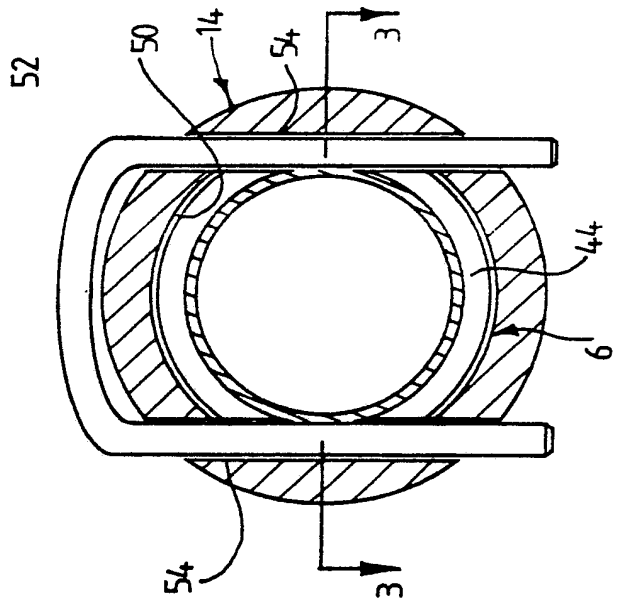


FIG 2



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 89/00042

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] F28D 7/10, F28F 9/06, 9/14

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	F28D 7/10, F28F 9/06, 9/14, 9/12

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU : IPC as above; Australian Classification 29.5

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	GB,A, 1590196 (PAIN) 28 May 1981 (28.05.81)	
A	GB,A, 884924 (LUMMUS NEDERLAND N.V.) 20 December 1961 (20.12.61)	
P,A	GB,A, 2204945 (NUOVOPIGNONE-INDUSTRIE MECCANICHE E FONDERIA SpA) 23 November 1988 (23.11.88)	
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
12 May 1989 (12.05.89)	24 May 1989 (24.05.89)
International Searching Authority: Australian Patent Office	Signature of Authorized Officer: R. Hallett (R. HALLETT)

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